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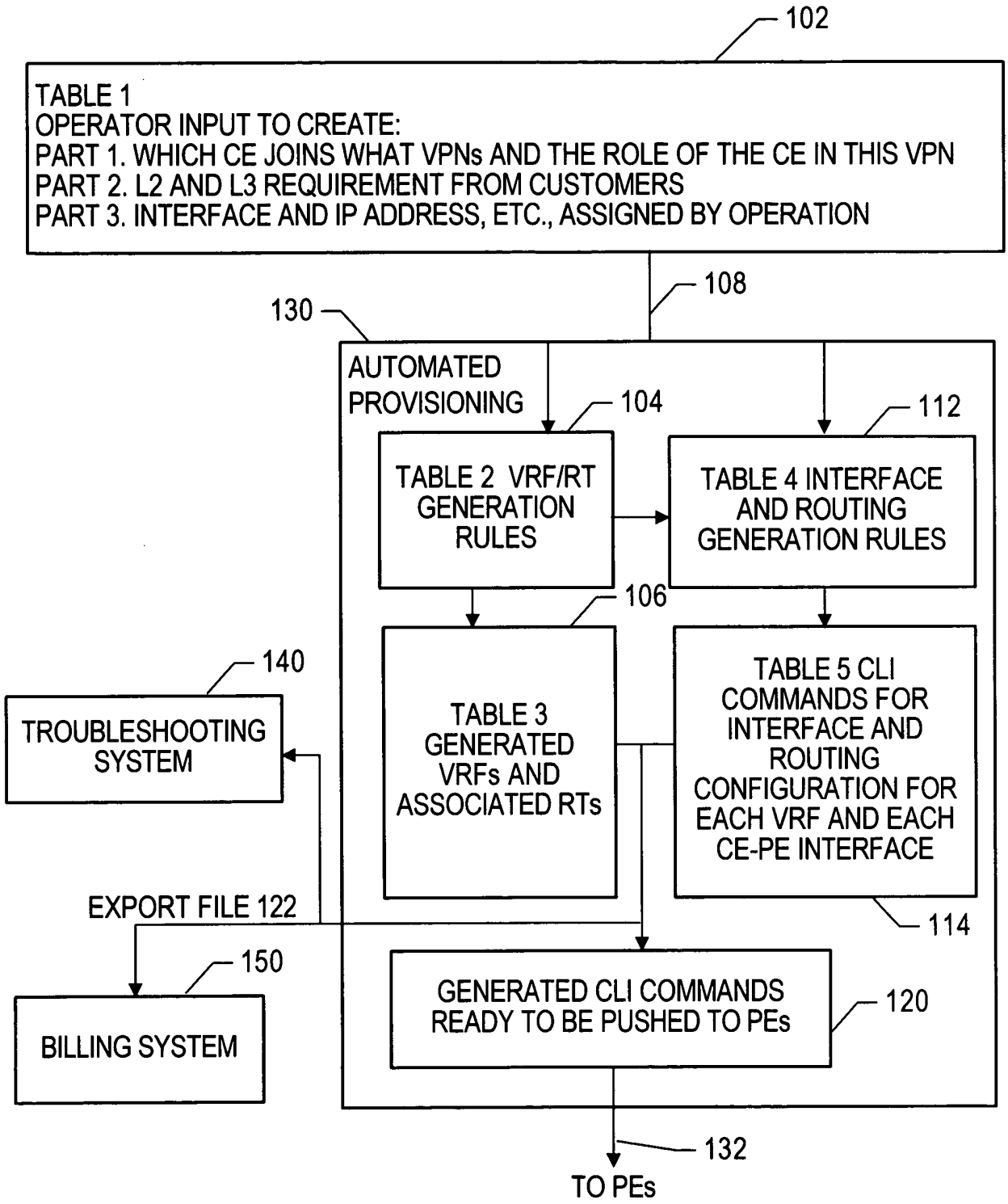
102
TABLE 1
OPERATOR INPUT TO CREATE:
PART 1. WHICH CE JOINS WHAT VPNs AND THE ROLE OF THE CE IN THIS VPN
PART 2. L2 AND L3 REQUIREMENT FROM CUSTOMERS
PART 3. INTERFACE AND IP ADDRESS, ETC., ASSIGNED BY OPERATION
108
130
AUTOMATED PROVISIONING
104
112
TABLE 2 VRF/RT GENERATION RULES
TABLE 4 INTERFACE AND ROUTING GENERATION RULES
106
140
TROUBLESHOOTING SYSTEM
TABLE 3 GENERATED VRFs AND ASSOCIATED RTs
TABLE 5 CLI COMMANDS FOR INTERFACE AND ROUTING CONFIGURATION FOR EACH VRF AND EACH CE-PE INTERFACE
114
EXPORT FILE 122
150
BILLING SYSTEM
GENERATED CLI COMMANDS READY TO BE PUSHED TO PEs
120
132
TO PEs

FIG. 1

EXAMPLE OF MPLS/VPN SERVICE PROVISIONING TABLE 102

		Customer A											Customer B	
		CE1	CE2	CE3	CE4	CE5	CE6	CE7	CE8	CE9				
Part 1 202	Full Mesh													
	Full Mesh													
	Full Mesh													
	Central Service		Server		Client				Server	Client		Client		
	H&S 2 VRFs	Spoke				Spoke	Hub_Spk	Hub_Hub		Spoke				
	H&S 1 VRF			Hub							Spoke	Spoke	Spoke	Spoke
Part 2 204	L2 requirement Encapsulation, CRC, Clock, ATM VC, etc)	VBR2M/ 2M/32	PPP CRC 32	PPP CRC 32	FR CRC 32	PPP CRC 32	Aal5snap UBR	FR		PPP CRC 16	CRC 32	PPP CRC 32	FR 32	PPP 16
	L3 requirement Routing Area/AS,	Area 0		RIP	Area 0	Area 7	Static	Area 0	RIP			Area 1	RIP	Static
	Location of CE	LA	SF	SF	LA	SJ	SJ	SJ	SJ	SF	LA	SF	LA	LA
Part 3 206	IP interface on PE	PE1 ATM4/ 4.10	PE2 POS3/0	PE2	PE1	PE3	PE3 ATM4/ 0.1	PE3 S1/0/15.0	PE3 GE2/0	PE2 POS3/1	PE1	E2	PE1	PE1 POS3/
	IP address/mask	IP address/mask can be assigned manually or automatically from IP address pools.												
	Inbound QoS (profile #)							10						
	Outbound QoS (profile #)							10						
	MD5													
	Others													

TABLE 2: LOGICAL MAPPING OF VRF AND ASSOCIATED RTs TO VPN FOR DIFFERENT TOPOLOGIES

FM = FULL MESH HB1 = ONE VRF BASED HUB AND SPOKE HB2 = TWO VRF BASED HUB AND SPOKE
CS = CENTRAL SERVICE n = SEQUENCE NUMBER OF VPN m = SEQUENCE NUMBER OF CE

302 VPN TOPOLOGY	304 VRF (IN BOLD) AND RTS (IN ITALIC)			306 NOTES
FULL MESH 310	**VRF_FM_n** *Both FM_n*			One VRF on Each PE One RT per VRF
H&S TWO BASED 312	**VRF_HS2_HUB_Hub** Import *HS2_n_Hub*	**VRF_HS2_HUB_Spoke** *Export HS2_n_Spoke*	**VRF_HS2_Spoke_m** *Export HS2_n_Hub* *Export HS2_n_Spoke*	One VRFs for each CE (even on PE) One unique RT for HUB_Hnb VRF One unique RT for HUB_Spoke VRF Two RTs for each spoke CE CE VRF on different PEs.
H&S ONE VRF BASED **(WITH DEFAULT ROUTE)** 314	**VRF_HS1_HUB** *Export HS1_n Spoke* *Import HS1_n_Hub*		**VRF_HS1_Spoke_m** *Export HS1_n_Hub* *Import HS1_n_Spoke*	One VRFs for each CE (even on PE) Two RTs for HUB VRF Two RTs for Spoke CE VRF but they are same for all CE VRF on different PEs.
CENTRAL SERVICE 316	**VRF_CS_n_Server** *Both CS_n_Server Import CS_n_Server_Import*		**VRF_CS_n_Spoke_m** *Export CS_n_Server_Import* *Import CS_n_Server*	One VRF for each CE Two RTs for Server VRF Two RTs for each Spoke VRF
	330	332	334	

FIG. 3

ON PE1 440

		420 CE1	422 CE4	424	426	428	430
402	Full Mesh	*Both FM_1*	*Both FM_1*	*Both FM_1*	*Both FM_1*	*Both FM_1*	
404	Full Mesh	*Both FM_2*	*Both FM_2*				
406	Full Mesh			*Both FM_3*			
408	Central Service		*Export CS_4_Server_Import* *Import CS_4_Server_Import*				
410	H&S 2 VRFs	*Export HS2_5_Hub* *Import HS2_5_Spoke*					
412	H&S 1 VRF			*Export HS1_6_Hub* *Import HS1_6_Spoke*	*Export HS1_6_Hub* *Import HS1_6_Spoke*	*Export HS1_6_Hub* *Import HS1_6_Spoke*	
VRF on PE1 414		**VRF_1**	**VRF_2**	**VRF_3**	**VRF_4** 432		

ON PE2 450

		CE2	CE3	CE9	
	Full Mesh			*Both FM_1*	
	Full Mesh				
	Full Mesh	*Both FM_3*	*Both FM_3*		*Both FM_3*
	Central Service	*Both CS_4_Server Import* *CS_4_Server_Import*		*Export CS_4_Server_Import* *Import CS_4_Server_Export*	*Export CS_4_Server_Import* *Import CS_4_Server_Export*
	H&S 2 VRFs			*Export HS1_5_Hub* *Import HS1_5_Spoke*	
	H&S 1 VRF		*Export HS1_6_Spoke* *Import HS1_6_Hub*		*Export HS1_6_Hub* *Import HS1_6_Spoke*
VRF on PE2		**VRF_1**	**VRF_2**	**VRF_3**	**VRF_4**

FIG. 4A

Docket No.: 1033-LB1029
Inventor: Chen, et al.
Attorney: Russell W. White (512) 327-5515

ON PE3 460

	Topology	CE5	CE6	CE7	CE8
	Full Mesh				
	Full Mesh			*Both FM_2*	
	Full Mesh				*Both FM_3*
	Central Service				*Both CS_4_Server* *Import CS_4_Server_Import*
	H&S 2 VRFs	*Export HS2_5_Hub* *Import HS2_5_Spoke*	*Export HS2_5_Spoke*	*Import HS2_5_Hub*	*Export HS2_5_Hub* *ImportHS2_5_Spoke*
VRF on PE3		**VRF_1**	**VRF_2**	**VRF_3**	**VRF_4**

FIG. 4B

FIG. 4A
FIG. 4B

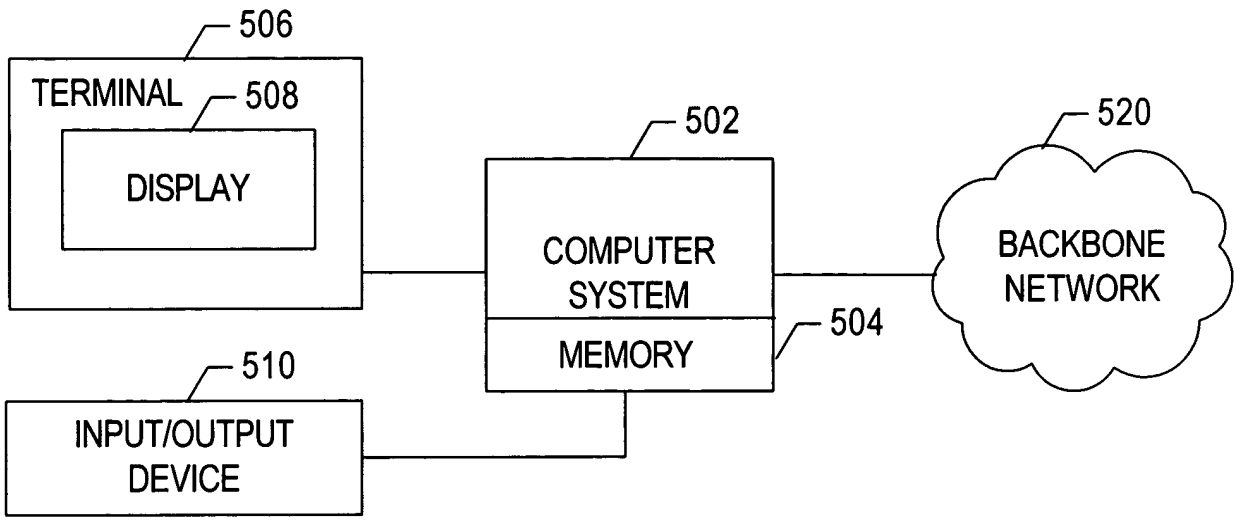
506
TERMINAL
508
DISPLAY
502
COMPUTER SYSTEM
MEMORY
504
520
BACKBONE NETWORK
510
INPUT/OUTPUT DEVICE

FIG. 5

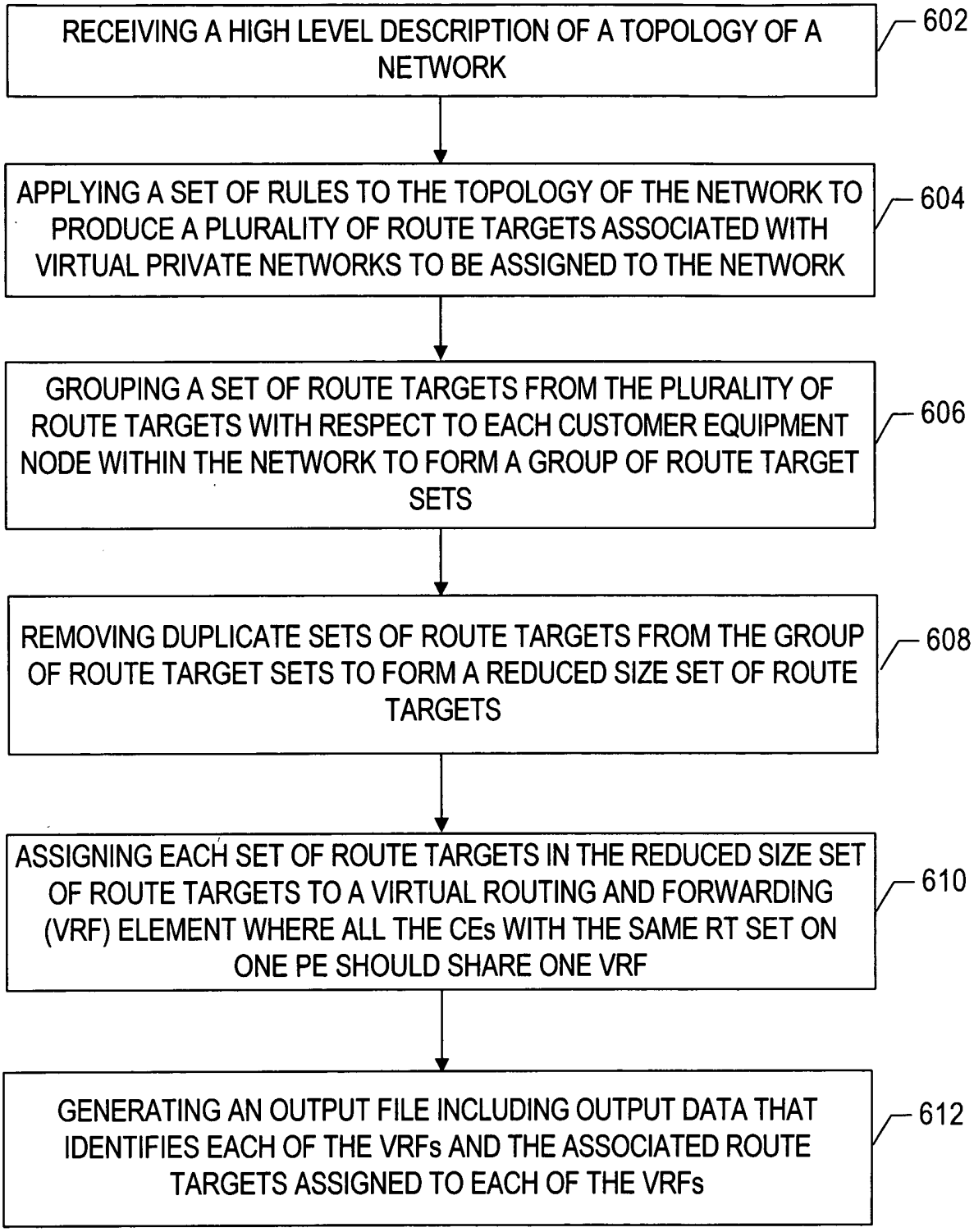
RECEIVING A HIGH LEVEL DESCRIPTION OF A TOPOLOGY OF A NETWORK
602
APPLYING A SET OF RULES TO THE TOPOLOGY OF THE NETWORK TO PRODUCE A PLURALITY OF ROUTE TARGETS ASSOCIATED WITH VIRTUAL PRIVATE NETWORKS TO BE ASSIGNED TO THE NETWORK
604
GROUPING A SET OF ROUTE TARGETS FROM THE PLURALITY OF ROUTE TARGETS WITH RESPECT TO EACH CUSTOMER EQUIPMENT NODE WITHIN THE NETWORK TO FORM A GROUP OF ROUTE TARGET SETS
606
REMOVING DUPLICATE SETS OF ROUTE TARGETS FROM THE GROUP OF ROUTE TARGET SETS TO FORM A REDUCED SIZE SET OF ROUTE TARGETS
608
ASSIGNING EACH SET OF ROUTE TARGETS IN THE REDUCED SIZE SET OF ROUTE TARGETS TO A VIRTUAL ROUTING AND FORWARDING (VRF) ELEMENT WHERE ALL THE CEs WITH THE SAME RT SET ON ONE PE SHOULD SHARE ONE VRF
610
GENERATING AN OUTPUT FILE INCLUDING OUTPUT DATA THAT IDENTIFIES EACH OF THE VRFs AND THE ASSOCIATED ROUTE TARGETS ASSIGNED TO EACH OF THE VRFs
612

FIG. 6

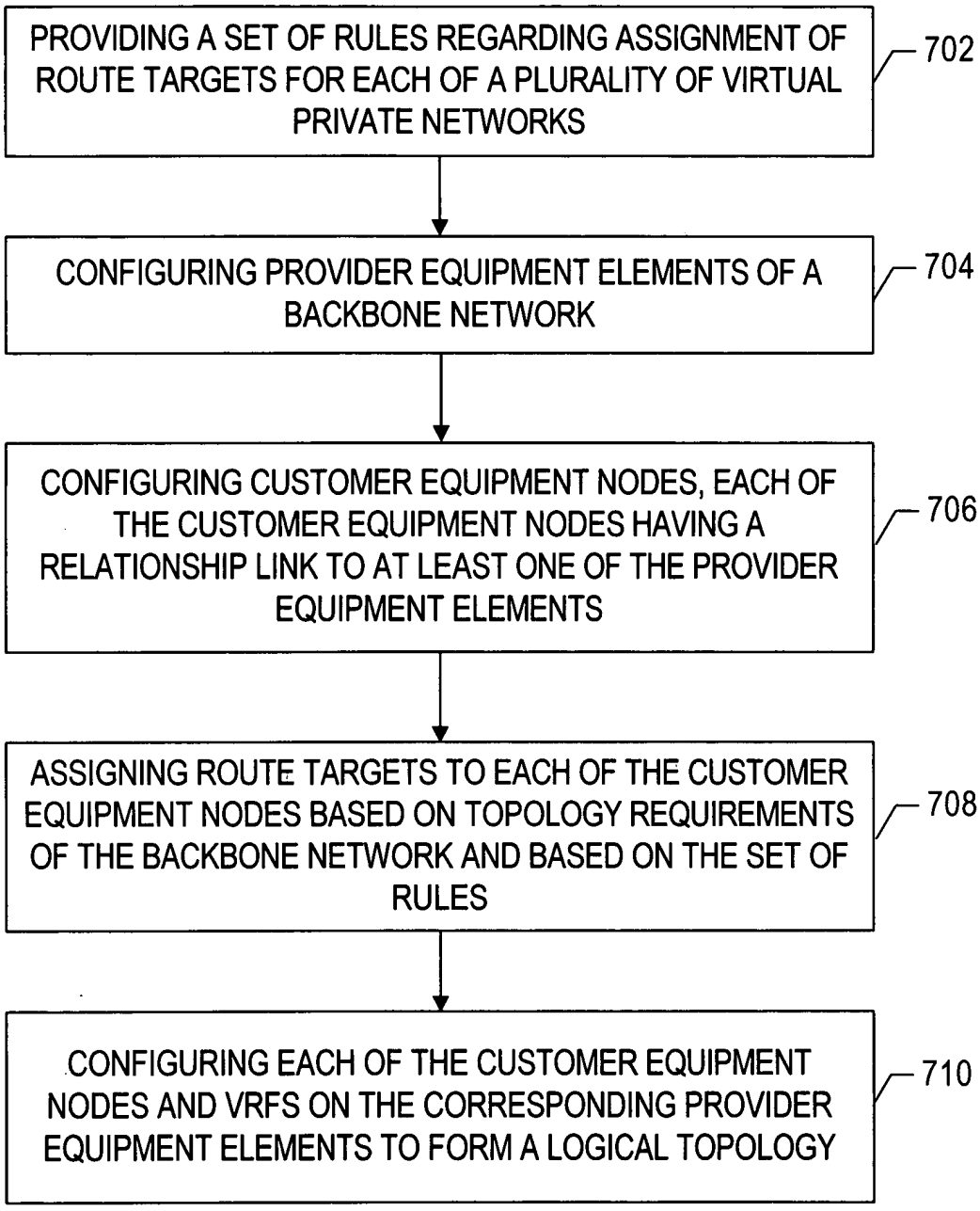
PROVIDING A SET OF RULES REGARDING ASSIGNMENT OF ROUTE TARGETS FOR EACH OF A PLURALITY OF VIRTUAL PRIVATE NETWORKS
702
CONFIGURING PROVIDER EQUIPMENT ELEMENTS OF A BACKBONE NETWORK
704
CONFIGURING CUSTOMER EQUIPMENT NODES, EACH OF THE CUSTOMER EQUIPMENT NODES HAVING A RELATIONSHIP LINK TO AT LEAST ONE OF THE PROVIDER EQUIPMENT ELEMENTS
706
ASSIGNING ROUTE TARGETS TO EACH OF THE CUSTOMER EQUIPMENT NODES BASED ON TOPOLOGY REQUIREMENTS OF THE BACKBONE NETWORK AND BASED ON THE SET OF RULES
708
CONFIGURING EACH OF THE CUSTOMER EQUIPMENT NODES AND VRFS ON THE CORRESPONDING PROVIDER EQUIPMENT ELEMENTS TO FORM A LOGICAL TOPOLOGY
710

FIG. 7

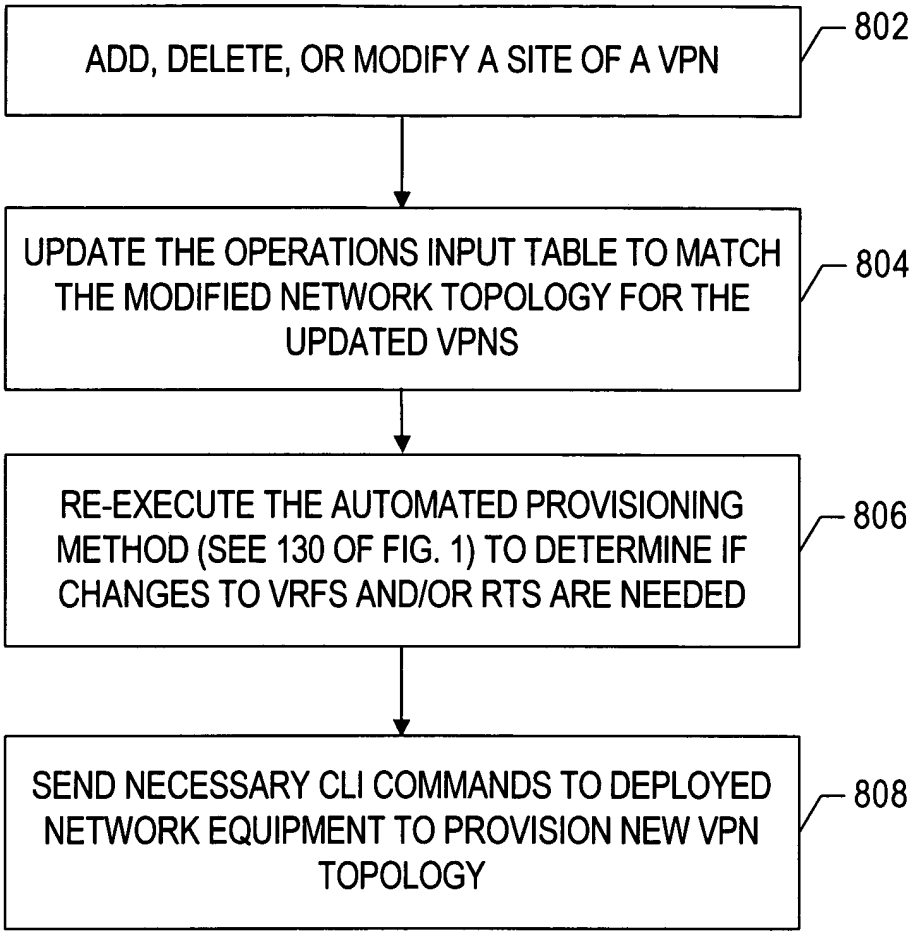
ADD, DELETE, OR MODIFY A SITE OF A VPN
802
UPDATE THE OPERATIONS INPUT TABLE TO MATCH THE MODIFIED NETWORK TOPOLOGY FOR THE UPDATED VPNS
804
RE-EXECUTE THE AUTOMATED PROVISIONING METHOD (SEE 130 OF FIG. 1) TO DETERMINE IF CHANGES TO VRFS AND/OR RTS ARE NEEDED
806
SEND NECESSARY CLI COMMANDS TO DEPLOYED NETWORK EQUIPMENT TO PROVISION NEW VPN TOPOLOGY
808

FIG. 8